

chapter one precedes the elucidation of the main principles of gauge theory in chapter two.

In reading the book, I came upon an unusually large number of misprints, as well as occasional misleading statements. An example of the latter is the authors' statement (page 56) that the estimated total energy density of the universe is large enough to lead to a closed universe. Actually, we do not know at present whether the universe is open or closed. Most of the misprints are obvious and do no harm, but I worry that there may be others, not so obvious, that I failed to detect. A most peculiar editorial inconsistency is that while the preface and title page indicate that the present volume is the first of two, the authors, in their concluding remarks, say that it is the first of three: Volume 2, they say, will provide additional material on the static properties of hadrons, on grand unified theories, and on the early universe, and volume 3 will cover hadron scattering processes. Judging from the first volume, the remaining one or two will provide very valuable source material on these subjects.

DON B. LICHTENBERG
Indiana University

E. B. Christoffel: The Influence of His Work on Mathematics and the Physical Sciences

P. Butzer, F. Feher, eds.
761 pp. Birkhauser, Boston, 1981. \$44.95

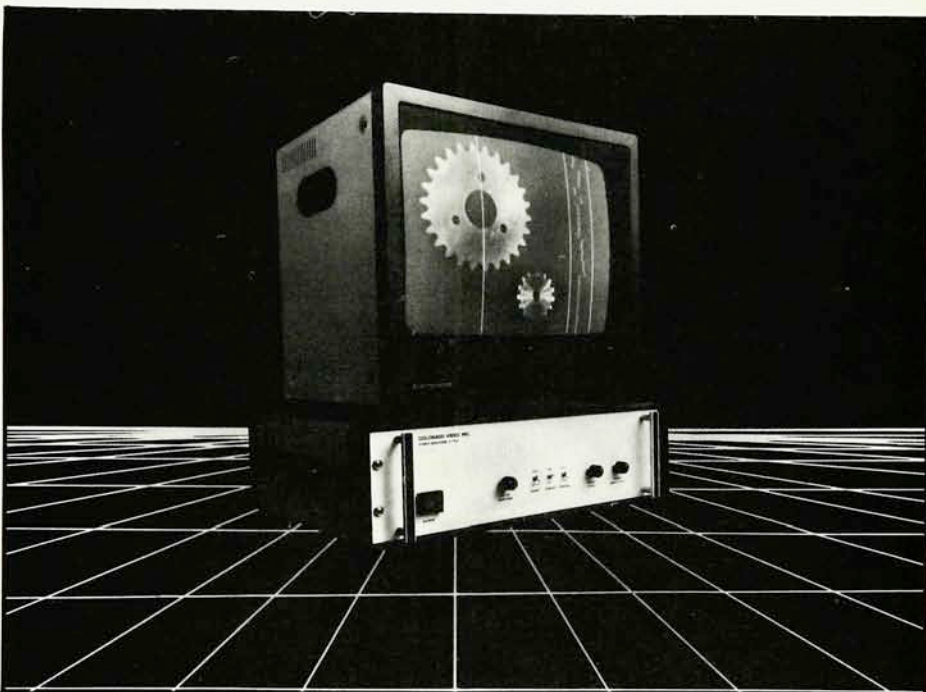
This jubilee volume celebrates the 150th anniversary of the birth of Edwin Bruno Christoffel (1829-1900). Christoffel's name remains widely known because of the use of the term "Christoffel symbols" to designate connection coefficients in differential geometry and relativity theory. His research, in fact, extended beyond geometry to many other branches of mathematics and mathematical physics. In many fields—notably numerical analysis, complex function theory, and differential equations as well as geometry—Christoffel's work has been of considerable importance to subsequent developments. The extent of his legacy is admirably documented by the present quadrilingual collection of 55 papers and many short commentaries, which serves as an introduction both to Christoffel's work and to present-day research related to it. The combination of (more or less technical) historical articles, long surveys of recent research, and short research notes provides materials of great value for a complete assessment of Christoffel's contributions. The quality and readability of these articles is exceptionally high, and the mathematical reader is

almost certain to find much of interest.

I mention specifically the mathematical reader, for almost all the articles are aimed primarily at mathematicians. This preponderance reflects Christoffel's main research interests: Only three of his thirty-five publications deal with physics directly. Furthermore, his physical investigations treated electric conduction and optical dispersion, two areas that changed drastically even during his lifetime. His physical works, therefore, are prin-

cipally of historical interest.

In the mathematical articles, however, there is much material to interest the physicist, especially the theorist. For example, several papers examine the relationship between Christoffel's geometrical work and modern gauge field theories. In this vein, Jürgen Ehlers gives a concise discussion of the physical importance of connections on principal bundles that is both accessible and illuminating. Another of Christoffel's major contributions was



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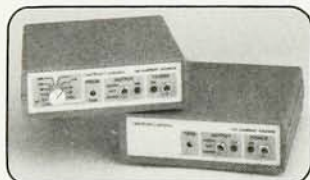
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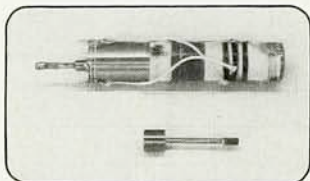
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the study of the propagation of shock waves in elastic solids, and the articles by F. Atkinson and by W. Arrenbrecht and J. Ballmann examine developments in this theory since the time of Christoffel. In a more applied context, Lloyd Trefethen gives an amusing computer application of the Schwarz-Christoffel transformation to the design of trimmed film resistors. The list could be extended by referring to papers on potential theory, dynamical systems, boundary-value problems and other fields.

Besides the technical articles, there are historical essays of general interest. Christoffel's career and its institutional setting receive special attention; articles by M. A. Knus, E. Knobloch and F. R. Wollmershäuser provide much insight into the working of mathematics and the physical sciences in Zürich, Berlin, and Strassburg during Christoffel's time. While these informative essays fall short of giving a detailed account of the process of development that unites Christoffel's diverse interests, they go far towards making such an account possible. This task will be further facilitated by the detailed investigation of different aspects of his technical work that appear throughout the text.

I have only one minor complaint about the volume, that it attempts to rank Christoffel as a mathematician with respect to his contemporaries. In the absence of clear criteria for such a ranking, this seems to me a pointless exercise, the more so because the contributions of many scientists with whom Christoffel is compared—for example, E. Beltrami, C. J. Sturm, H. A. Schwarz and Carl Neumann—have received little attention from historians.

Indeed, the great contribution of this volume is to permit a thorough assessment of Christoffel's contribution, both in his own day and to later generations. It does an excellent job of portraying the richness of his thought and the fruit it continues to bear. In so doing, the book honors the memory of Christoffel and helps us to understand the enormous and complex debt of present-day science to that of the nineteenth century.

TOM ARCHIBALD
University of Toronto

book notes

McGraw-Hill Encyclopedia of Physics
S. P. Parker, ed. 1343 pp. McGraw-Hill, New York, 1983. \$54.50

McGraw-Hill Encyclopedia of Astronomy
S. P. Parker, ed. 450 pp. McGraw-Hill, New York, 1983. \$44.50

These two volumes contain relevant